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## USE OF ARTIFICIAL INTELLIGENCE IN RISK MANAGEMENT OF INDUSTRIAL ENTERPRISES

### ВИКОРИСТАННЯ ШТУЧНОГО ІНТЕЛЕКТУ В УПРАВЛІННІ РИЗИКАМИ ПРОМИСЛОВИХ ПІДПРИЄМСТВ

**Abstract.** The article examines the theoretical and practical aspects of using artificial intelligence in the risk management system of industrial enterprises. It is substantiated that traditional risk management approaches based on historical data and expert judgment do not provide sufficient effectiveness under conditions of high uncertainty and a dynamic external environment. The essence of artificial intelligence as a tool for analyzing large volumes of structured and unstructured data is defined, along with its role in improving the quality of managerial decision-making. Key areas of artificial intelligence application in the processes of risk identification, assessment, forecasting, and monitoring are analyzed. It is established that the use of machine learning algorithms, deep learning, natural language processing, and Big Data analytics contributes to improving the accuracy of risk assessment and facilitates the transition from reactive to proactive management. The advantages of AI application are substantiated, including process automation, increased speed of processing large volumes of information in real time, reduction of the human factor influence, and adaptability to environmental changes. The features of artificial intelligence application in managing financial, operational, strategic, regulatory, and technical risks are considered. The expediency of using integrated digital platforms and hybrid models combining the capabilities of artificial intelligence and human intelligence is proven. The main implementation challenges are identified, including the opacity of algorithms leading to difficulties in model interpretation, risks of confidential data leakage, algorithmic bias, and insufficient staff qualifications. Practical recommendations for improving risk management efficiency are proposed, including phased implementation of AI, development of digital competencies, ensuring data quality and security, and integration of intelligent systems into key business processes. It is proven that the use of artificial intelligence is an essential condition for ensuring the resilience and competitiveness of industrial enterprises in the digital economy.

**Keywords:** artificial intelligence, risk management, industrial enterprises, digital transformation, machine learning, Big Data, proactive management, hybrid models, management efficiency.

**Анотація.** У статті досліджено теоретичні та практичні аспекти використання штучного інтелекту в системі управління ризиками промислових підприємств. Обґрунтовано, що традиційні підходи до ризик-менеджменту, засновані на історичних даних і експертних оцінках, не забезпечують достатньої ефективності в умовах високої невизначеності та динамічності зовнішнього середовища. Визначено сутність штучного інтелекту як інструменту аналізу великих обсягів структурованих і неструктурованих даних та його роль у підвищенні якості управлінських рішень. Проаналізовано ключові напрями застосування штучного інтелекту у процесах ідентифікації, оцінки, прогнозування та моніторингу ризиків. Встановлено, що використання алгоритмів машинного навчання, глибокого навчання, обробки природної мови та аналітики великих даних сприяє підвищенню точності оцінювання ризиків і переходу від реактивного до проактивного управління. Обґрунтовано переваги використання ШІ, зокрема автоматизацію процесів, підвищення швидкості обробки великих обсягів інформації в реальному часі, зниження впливу людського фактора та адаптивності до змін середовища. Розглянуто особливості застосування штучного інтелекту

для управління фінансовими, операційними, стратегічними, регуляторними та технічними ризиками. Доведено доцільність використання інтегрованих цифрових платформ і гібридних моделей, що поєднують можливості ШІ та людського інтелекту. Визначено основні виклики впровадження, серед яких непрозорість алгоритмів, що призводить до складності інтерпретації моделей, ризики витоку конфіденційних даних, алгоритмічні упередження та недостатній рівень кваліфікації персоналу. Запропоновано практичні рекомендації щодо підвищення ефективності управління ризиками, які передбачають поетапне впровадження ШІ, розвиток цифрових компетенцій, забезпечення якості та безпеки даних, а також інтеграцію інтелектуальних систем у ключові бізнес-процеси підприємства. Доведено, що використання штучного інтелекту є важливою умовою забезпечення стійкості та конкурентоспроможності промислових підприємств у цифровій економіці.

**Ключові слова:** штучний інтелект, управління ризиками, промислові підприємства, цифрова трансформація, машинне навчання, Big Data, проактивне управління, гібридні моделі, ефективність управління.

**Problem Statement.** Modern industrial enterprises operate under conditions of high uncertainty, dynamic market changes, technological transformations, and an increasing level of risks. Traditional risk management approaches based on historical data, expert judgment, and static models are increasingly proving insufficient for timely responses to complex, multifactor threats [13, p. 261]. This necessitates the search for new tools capable of ensuring more flexible, accurate, and prompt risk management.

One such tool is artificial intelligence (AI), which represents a set of technologies that imitate human cognitive functions and include machine learning, neural networks, and natural language processing [3, p. 311]. Its application enables deep analysis of large volumes of both structured and unstructured data, opening opportunities for identifying hidden patterns, forecasting risk events, and improving the validity of managerial decisions [8, p. 321]. AI is particularly important in the processes of risk identification, assessment, forecasting, and monitoring, where machine learning algorithms automate data analysis from various sources, including production systems and the external environment [6, pp. 163-164], and enable the development of preventive response measures.

At the same time, the implementation of AI is accompanied by several challenges, including issues of algorithm transparency, data confidentiality, and ethical decision-making [8, p. 322]. Despite this, the experience of leading companies demonstrates that integrating AI into risk management systems contributes to increased efficiency of production processes, cost reduction, and sustainable enterprise development [5, p. 80]. Therefore, studying the possibilities of applying AI in risk management of industrial enterprises is a relevant and important research direction.

**Analysis of Recent Research and Publications.** The scientific studies indicate a growing interest in the use of artificial intelligence in enterprise risk management. In particular, the work of Obodiak V. K. et al. [8] substantiates the feasibility of using AI for automated cyber risk detection and proposes a hybrid approach combining algorithms with expert judgment. Zabranskyi M. V. and Semenchuk T. B. [5] emphasize the importance of AI in strategic planning under uncertainty. Kirovych A. F. [6] considers the integration of digital technologies (AI, IoT, Big Data) as a basis for improving risk management efficiency.

The study by Riabchykov O. M. [9] demonstrates the effectiveness of AI in agile project environments, while Dashko I. M. and Nykonchuk H. V. [2] highlight its role in improving the quality of managerial decision-making. Similar conclusions are confirmed by the works of Drynov D. M. et al. [4] and Savchenko M. [1], which prove

the positive impact of AI on the speed and accuracy of risk assessment.

At the same time, several issues remain unresolved, including data quality and misinformation problems [14], ethical aspects, algorithm transparency, and the adaptation of AI models to the specifics of industrial enterprises. This determines the need for further research in this area.

**Purpose of the Article.** The purpose of this study is a comprehensive analysis of the possibilities of using artificial intelligence technologies in the risk management system of industrial enterprises, as well as determining their impact on the effectiveness of managerial decision-making. Particular attention is paid to the role of AI in the processes of risk identification, assessment, forecasting, and monitoring, as well as to identifying the advantages and limitations of its application. In addition, the study aims to generalize modern approaches to integrating AI into risk management and to develop practical recommendations for improving risk management efficiency under conditions of digital transformation of enterprises.

**Presentation of the main research material.** Under modern conditions of industrial enterprise operation, risk management acquires strategic importance, as the stability and competitiveness of an organization largely depend on its ability to timely identify, assess, and minimize risks. The digital transformation of the economy necessitates the use of innovative tools, among which AI occupies a leading position, providing a fundamentally new level of analytical capabilities [10].

Traditional approaches to risk management are based on the use of historical data, expert evaluations, and static models. However, such approaches have limitations related to low adaptability to rapid environmental changes and the difficulty of accounting for a large number of factors [10; 13, p. 262]. In addition, they are often characterized by a high degree of subjectivity, as many decisions rely on the experience and intuition of management personnel. In highly turbulent market conditions, this may lead to delayed responses to threats and reduced management efficiency.

In contrast, AI enables the processing of large volumes of data in real time, ensuring more accurate and timely risk identification. Importantly, AI can work with both structured and unstructured data, including textual information, sensor data, financial reports, and external analytical sources. This significantly expands the information base for risk analysis and allows for a more comprehensive understanding of potential threats [7, p. 51].

The application of AI transforms the risk management paradigm from reactive to proactive. Through machine learning algorithms, enterprises can not only detect existing risks but also predict their occurrence, enabling the development of preventive response measures in advance

[4, p. 77]. Predictive models are capable of accounting for multifactor relationships, which are nearly impossible to implement using traditional approaches. As a result, the accuracy of risk assessment increases and uncertainty in managerial decision-making decreases.

Moreover, the use of AI facilitates the integration of various information sources, including internal corporate data and external factors (market trends, macroeconomic indicators, consumer behavior), significantly improving the quality of managerial decisions [13, p. 262]. Such integration makes it possible to create unified analytical platforms that ensure continuous risk monitoring and rapid response to environmental changes.

An important feature of AI application is also the ability to automate a significant portion of risk management processes. This reduces the workload on personnel, minimizes the impact of the human factor, and enhances the overall efficiency of the risk management system [8, p. 322]. At the same time, the role of analytical functions increases, particularly those related to interpreting algorithm outputs and forming strategic decisions.

The analysis of scientific sources allows for the identification of key areas of AI application in the risk management system of industrial enterprises (Table 1).

The identified areas cover the full cycle of risk management and reflect the transformation of this process under the influence of digital technologies.

Risk identification is the first stage of the risk management process and involves detecting potential threats to enterprise activities. The use of machine learning methods makes it possible to analyze large volumes of data, identifying hidden patterns and anomalies that may indicate risks [6, p. 163]. An important advantage is the ability of AI systems to consider weak signals and indirect risk indicators that are often overlooked in traditional approaches. This significantly enhances the completeness of threat identification.

At the risk assessment stage, algorithms are applied to determine the probability of risk events and their potential impact. Neural networks can account for complex interdependencies between variables, thereby improving assessment accuracy [8, p. 324]. Moreover, the use of AI enables the application of dynamic models that adapt to environmental changes and continuously refine evaluation results.

Risk forecasting is carried out using predictive modeling based on the analysis of historical and current data. This allows enterprises to develop future scenarios and prepare for potential threats [6, p. 163]. A key feature is the ability to model alternative scenarios, which enhances the validity of strategic decisions.

AI-based risk monitoring ensures continuous tracking of changes in enterprise performance indicators and the

external environment. This enables prompt detection of deviations from normal conditions and timely response. At the same time, AI-based decision support systems allow for selecting optimal courses of action, taking into account multiple criteria and constraints [6, p. 164].

The effectiveness of AI application in risk management largely depends on the technological foundation, which includes the following components: machine learning, deep learning, natural language processing, and Big Data analytics. These technologies form the basis of modern intelligent systems that ensure a high level of automation, adaptability, and analytical accuracy in risk management processes.

Machine learning is a key tool that enables systems to learn from data and generate predictions about future events. It involves the use of various types of algorithms - supervised, unsupervised, and reinforcement learning - allowing for solving a wide range of tasks, including risk classification, anomaly detection, and predictive modeling. A distinctive feature of machine learning is its ability to continuously improve models based on new data, ensuring their relevance in a dynamic environment [8, pp. 321-322].

Deep learning, as a subset of machine learning, is based on multilayer neural networks and enables the analysis of complex nonlinear relationships between variables [10]. This is particularly important in risk management, where interdependencies between factors are often complex and multi-level. As a result, deep learning improves the accuracy of risk forecasting, especially in cases where traditional statistical methods are insufficient.

Natural language processing is used to analyze unstructured data such as reports, news, contracts, technical documentation, and other textual sources [10]. This makes it possible to identify potential risks related to the information environment, including legislative changes, reputational threats, or signals of market instability. An important advantage of this technology is the ability to integrate qualitative information into quantitative risk analysis models, significantly increasing their informativeness.

Big Data analytics enables the processing of information from various sources, including production systems, financial reports, logistics data, and sensor readings, significantly expanding analytical capabilities [13, p. 262]. The use of Big Data technologies – large volumes of structured and unstructured data that cannot be processed using traditional methods [12, p. 84] – allows not only the accumulation and storage of vast amounts of information but also their comprehensive real-time analysis [1, p. 47]. This, in turn, creates the conditions for timely detection of deviations and informed managerial decision-making.

The interaction of these technologies produces a synergistic effect, as their integrated use enables the

**Table 1 – Main Areas of AI Application in Risk Management System of Industrial Enterprises**

Area	Characteristics	Expected Effect
Risk identification	Analysis of large datasets, detection of anomalies and patterns	Timely identification of potential threats
Risk assessment	Development of models to evaluate probability and impact of risks	Increased accuracy of assessment
Forecasting	Use of predictive models and neural networks	Anticipation of future risk events
Monitoring	Continuous real-time data analysis	Prompt response to changes
Decision-making	Decision support systems	Optimization of strategy selection

Source: compiled based on [4; 6; 8; 13]

development of comprehensive risk management systems. Such systems can simultaneously perform data collection, processing, analysis, and interpretation, significantly improving the effectiveness of enterprise risk management. Moreover, their implementation facilitates the transition to digital management platforms that provide centralized access to information and enhance the transparency of managerial processes.

AI can be applied to manage various types of risks arising in the activities of industrial enterprises (Table 2). It is versatile due to the ability to process heterogeneous data and adapt algorithms to the specifics of particular managerial tasks.

The application of AI in financial risk management enables deep analysis of market trends, price dynamics, currency fluctuations, and other economic indicators. Machine learning algorithms are capable of identifying patterns in financial data and generating forecasts of potential losses or instability, thereby improving the validity of investment decisions [11]. In addition, the use of AI allows for the automation of financial control processes and the timely detection of deviations from planned indicators.

In the area of operational risks, the use of AI for monitoring production processes is of particular importance. Through the analysis of data from sensors, automation systems, and production equipment, continuous control over enterprise performance parameters is ensured [7, p. 52]. This makes it possible to detect even minor deviations from normal operating conditions, which may indicate potential failures or emergencies. Thus, timely response and loss minimization are ensured.

Strategic risks are associated with long-term managerial decisions, and here artificial intelligence demonstrates significant potential through scenario modeling. Intelligent systems make it possible to evaluate different development scenarios while considering multiple factors, which contribute to the formation of more resilient enterprise development strategies [2, p. 85].

Regulatory risks can also be effectively managed using AI, particularly through the analysis of changes in legislation and regulatory acts. Natural language processing technologies enable the automatic analysis of

textual information and the identification of changes that may affect enterprise activities [11].

In the context of technical risks, AI application is based on the analysis of sensor data and equipment diagnostics systems. This enables predictive maintenance, aimed at preventing failures and accidents rather than eliminating them after occurrence [1, p. 47]. Such an approach significantly increases the reliability of production systems and reduces repair costs.

The implementation of AI provides a number of significant advantages for the risk management system, which explains its active adoption in industrial enterprises (Table 3). The use of intelligent technologies enhances the efficiency of all stages of risk management – from identification to control and mitigation of consequences.

One of the key advantages of AI is its high speed of information processing. Modern algorithms are capable of analyzing large volumes of data in real time, enabling rapid risk detection and quick responses to changes in both external and internal environments. This is particularly important for industrial enterprises, where delays in information processing may lead to significant financial losses.

Improved accuracy of managerial decisions is achieved by minimizing the influence of the human factor. AI algorithms rely on objective data analysis and are not subject to subjective biases, allowing for more reliable risk assessment results [2, p. 86]. Furthermore, AI can simultaneously account for a large number of variables, which is practically impossible using traditional methods.

Another important advantage is the ability to forecast risks. The use of machine learning models makes it possible to predict the likelihood of undesirable events, facilitating the timely implementation of preventive measures. This ensures the transition from reactive to proactive risk management.

Automation of risk management processes contributes to cost reduction and increased operational efficiency. In particular, automated systems can perform routine analytical operations, allowing personnel to focus on strategic tasks.

The flexibility of AI systems is reflected in their ability to adapt to changing operating conditions. Algorithms

**Table 2 – Application of AI Depending on Risk Type**

Type of risk	AI application	Result
Financial	Forecasting market changes, analysis of financial indicators	Reduction of financial losses
Operational	Monitoring of production processes	Increased efficiency
Strategic	Scenario modeling	Support for strategic decisions
Regulatory	Tracking legislative changes	Ensuring compliance
Technical	Analysis of sensor data	Prevention of failures and accidents

Source: compiled based on [1; 2; 7; 11]

**Table 3 – Advantages of Using AI in Risk Management**

Advantage	Description
High data processing speed	Analysis of large volumes of information in real time
Increased accuracy	Reduction of human factor influence
Forecasting capability	Ability to predict risks
Automation	Reduction of management costs
Flexibility	Adaptation to environmental changes

Source: compiled based on [2; 8; 10]

can quickly adjust to new data, ensuring the relevance of analytical results and enhancing enterprise resilience to risks.

In addition, decision support systems enable the evaluation of alternative options and the selection of optimal solutions, thereby improving management efficiency. Such systems provide a comprehensive analysis of situations, considering various criteria and constraints, and it contributes to better-informed managerial decision-making.

Despite the significant advantages, the use of AI is accompanied by a number of challenges that may limit its effective implementation in the risk management systems of industrial enterprises (Table 4). These challenges are both technological and organizational in nature, requiring a comprehensive approach to overcome them.

Among the main issues are: lack of algorithm transparency (the “black box” effect), data confidentiality risks, algorithmic bias, and insufficient staff qualifications. These problems may affect the reliability of analytical results, the level of trust in AI systems, and the effectiveness of managerial decisions.

One of the key challenges is the opacity of AI algorithms. Many modern models, particularly neural networks, are characterized by complex internal structures, which make it difficult to understand their functioning logic. This creates challenges in interpreting results and reduces user trust [8, p. 325]. The issue of model explainability is especially important, as it directly affects the feasibility of their practical application in risk management. To address this, Explainable AI (XAI) approaches are used to enhance transparency and ensure interpretability of results.

Data confidentiality risks also represent a significant limitation. The use of AI involves processing large volumes of information that may include commercially sensitive or personal data. If protection measures are insufficient, there is a risk of data leakage or unauthorized use [12, p. 88]. This necessitates the implementation of advanced cybersecurity measures and the development of appropriate data governance policies.

Algorithmic bias arises when models are trained on incomplete or unrepresentative datasets, potentially leading to distorted analytical results and ineffective decisions [14, p. 289]. To minimize such risks, it is essential to ensure high-quality input data, conduct regular audits of algorithms, and apply validation methods.

Another important challenge is the insufficient level of staff qualification. Effective use of AI requires specialized knowledge in data analysis, programming, and information systems management. A lack of such competencies can significantly reduce the effectiveness of AI implementation [2, p. 86]. Therefore, staff training and professional development are critical.

Effective use of artificial intelligence requires its systematic integration into the overall enterprise

management system. This involves not only the implementation of technological solutions but also the transformation of organizational processes, management approaches, and corporate culture. A key role in this process is played by the combination of technological tools with human expertise, as humans provide strategic vision, contextual evaluation, and final decision-making.

Research shows that the most effective approach is a hybrid model, where artificial intelligence performs analytical functions, while humans are responsible for control, interpretation, and decision-making [2, p. 86; 8, p. 324]. This approach combines the speed and accuracy of AI with human critical thinking and experience, reducing the likelihood of errors related to both human factors and algorithmic limitations.

AI integration also involves embedding it into key business processes, including planning, control, and performance analysis systems. This ensures continuous information exchange between departments and contributes to the creation of a unified information environment for risk management. An important aspect is adapting the organizational structure to support intelligent systems, which may involve establishing specialized units or analytical teams.

In addition, the implementation of tools such as Management Cockpit enhances coordination and decision-making [4, p. 78]. These tools provide visualization of key performance indicators, integration of analytical information, and support for decision-making processes at different management levels. As a result, management transparency increases, and timely access to relevant information is ensured.

The application of artificial intelligence enables the implementation of a proactive approach to risk management, which includes early threat detection, risk forecasting, and the development of preventive measures. This approach significantly differs from the traditional reactive model, which is based on responding to already realized risk events, and provides a much higher level of enterprise resilience to internal and external challenges [4, p. 77].

Early threat detection is one of the key elements of the proactive approach. Through the use of machine learning algorithms and Big Data analytics, enterprises can identify potential risks at the early stages of their emergence. This is achieved by analyzing large volumes of information, including production indicators, financial data, and external factors, allowing even minor deviations from normal system functioning to be detected. As a result, responsiveness is improved and the likelihood of adverse events is reduced.

Risk forecasting is another important component of proactive management. AI makes it possible to build complex predictive models that account for multifactor dependencies and environmental dynamics. These models

**Table 4 – Key Challenges of Using AI in Risk Management and Ways to Overcome Them**

Problem	Essence	Solutions
Opacity	Difficulty in interpreting models	Explainable AI
Confidentiality	Risk of data leakage	Data protection
Bias	Distortion of results	Algorithm monitoring
Qualification	Insufficient knowledge	Staff training

Source: compiled based on [2; 8; 12; 14]

can assess the probability of risk events and determine their potential consequences. This enables the development of various scenarios and enhances the validity of strategic management decisions.

The development of preventive measures is a logical continuation of forecasting. Based on analytical insights, enterprises can proactively design actions aimed at minimizing or avoiding risks. These may include optimization of production processes, supply diversification, adjustments in financial policy, or the implementation of additional control systems. Such an approach not only reduces negative impacts but also improves overall operational efficiency.

An important advantage of the proactive approach is its systemic nature. Artificial intelligence ensures continuous monitoring of enterprise activities and the external environment, allowing timely updates of risk information and adaptation of management decisions. Moreover, it reduces uncertainty in decision-making by relying on objective data analysis and predictive assessments, thereby increasing trust in risk management systems and improving resource utilization [8, p. 323].

Modern approaches to integrating artificial intelligence into industrial enterprise risk management systems are based on a comprehensive combination of digital technologies, analytical tools, and organizational changes. A key direction is the implementation of integrated platforms that provide real-time data collection, processing, and analysis using machine learning, Big Data, and the Internet of Things. This enables a transition from fragmented to systemic risk management and ensures continuous monitoring of internal and external threats.

An important approach is the use of hybrid models, where AI performs analytical and forecasting functions,

while management personnel are responsible for interpretation and strategic decision-making. Such interaction enhances accuracy and reduces the impact of human bias. Early warning systems also play a significant role by enabling timely identification of potential risks and the development of preventive actions.

Practical recommendations include improving data quality, ensuring cybersecurity and algorithm transparency, developing employees' digital competencies, and adapting business processes to the use of intelligent systems. In addition, phased implementation of AI and the creation of a unified information environment are advisable to ensure effective and sustainable industrial enterprise risk management under digital transformation conditions.

**Conclusions.** The study has shown that the use of AI technologies is one of the key directions for improving risk management systems in industrial enterprises. AI enables efficient processing of large volumes of data, increases the accuracy of risk assessment, and allows for forecasting, facilitating the transition from reactive to proactive management.

It has been proven that the implementation of AI enhances the effectiveness of managerial decision-making, optimizes business processes, and reduces uncertainty. At the same time, it is associated with challenges such as algorithm transparency, data confidentiality, and the need for staff upskilling.

The feasibility of a hybrid approach combining artificial intelligence and human intelligence has been substantiated, as it ensures more effective risk management.

Thus, the integration of artificial intelligence into risk management systems is a necessary condition for increasing the competitiveness of industrial enterprises and ensuring their sustainable development in the digital economy.

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